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EFFECT OF ORGANIC MANURING AND N FERTILIZATION LEVEL ON FLORAL FERTILITY, INTER AND INTRA SPIKELET COMPETITIONS AND GRAIN YIELD POTENTIALITY OF THREE BREAD WHEAT CULTIVARS UNDER SANDY SOIL CONDITIONS

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ABSTRACT : Two field experiments were conducted in the Experimental Farm of the Faculty of Agriculture, Zagazig University at Khattara, Sharkia Governorate, Egypt during 2004/2005 and 2005/2006 seasons. The study aimed to investigate the effect of three organic manuraing rates (without, 25, 50 m^3/fad) and four N fertilization levels (30, 60, 90 120 kg N/fad) on floral fertility, inter and intra spikelet compitions and grain yield potentiality of three bread wheat cultivars (Gemmiza 9, Sakha 93 and Giza 168) under sandy soil conditions.

Addition the organic manure and the increase of the rate of addition to 50 m^3/fad was accompanied by a significant increase in each of the grain and straw yields and all their attributes in addition to improvement of grain number and weight distribution along rachis and rachilla. This improvement was attributed to the favourable effect on reducing the inter and in particular, the intra-spikelet competitions.

Gemmiza 9 was superior in all growth and yield attributes as it recorded the highest grain yield/fad followed by Sakha 93 and Giza 168 in descending order. This superiority was expressed in plant height and tillering which promoted stem apex development as was expressed in greater number of spikelets/spike with greater number and heavier grains per spikelet. At all spikelet locations along rachis gemmiza 9 had larger number of grains per spikelet. Also, at all grain locations along rachilla, this cultivar had heavier single grain weight. Due to all these superiorities more photosynthates were afforded for grain filling with lower inter and intra spikelet competitions, compared with Sakha 93 or Giza 168 cultivars.

Data of the combined analysis revealed that increasing N application level up to 120 kg N/fad significantly increased each of plant height, number of spikes/m^2, spike length, number and weight of grains/spike and grain and straw yields /fad. Meantime, the number of spikelets/spike, grain number distribution along rachis and average single grain weight distribution along rachis and rachilla, responded to N addition up to 90 N/fad, which significantly decreased inter and intra spikelet compitions.

The most observed interaction, was observed between wheat cultivars on one hand and each of organic manuring and N levels. In almost all cases, Gemmiza 9 was more efficient and more responsive than Sakha 93 or Giza 168, where the former was is need for a predicted N level of 123.3 to maximize the grain yield to 2.003 ton/fad compared with 128.0 kg N/fad needed by Skaha 93 to maximize this yield to 1.694 ton/fad. Giza 168 was the least efficient and responsive in this respect as it was in need for 240.9 kg N/fad in order to maximize the grain yield to only 1.680 ton/fad. Organic manuring played a compensative role where lower N level were, always, needed in the manured than in the unmanured plots

Key words : Wheat – organic manuring – N levels – cultivars – inter competition – intra competition.

INTRODUCTION

In Egypt, increasing wheat yield per unit area is a National target. To minimize the gab between production and consumption from wheat, intensive efforts are being paid for sustaining wheat productivity. Sandy soils are considered the main area for the agriculture extension. However, production of wheat in sandy soils is facing many problems, among them the low organic matter content and hence the poor soil fertility level.

A great attention is being paid to the use of bioagriculture in wheat production, using organic fertilizer, in order to reduce soil, water and air pollution through reducing the use of mineral fertilizer. Farmyard manure (FYM) has a considerable role in improving soil physical properties and thus availability of macro and micro nutrients as well as grain yield (Abd El-Nasser and Hussein, 2001, Basyouny, 2001, Tolessa and Friesen, 2001, Vanlavwe *et al.*

2001, Darwish *et al.,* 2002, Hassan and Mohey El-Din, 2002, Salib *et al.,* 2002 and Yang *et al.,* 2004). Also, Heluf (2002) reported an increment of 0.47 ton/ha in grain yield due to application of FYM during the first year over no FYM, whereas increasing FYM application from 0 to 20 t/ha increased wheat grain yield from 1.97 to 3.31 ton/ha. Moreover, Mowafy (2002-a) observed that each increase of FYM rate up to 45 m^3/fad significantly increased grain and straw yields/fad and all, their components. In addition, Khalil and Aly (2004) noticed that addition of 30 m^3/fad FYM produced the highest averages of number of spike/m^2, thousand grain weight and grain and straw yields/fad. Abdel-Ghani and Bakry (2005) noticed that addition of 120 kg compost/fad and or biofertilizer affected significantly wheat grain and straw yields and almost of their attributes. Furthermore, Ahmed and Ali (2005) observed that yield and its attributes of wheat was significantly increased due to the application of different organic manures.

Several workers reported significant varietal differences in yield attributes and yield potentiality among different Egyptian wheat cultivars (Mowafy, 2002-b, Allam, 2003, Ali *et al.,* 2004, Allam, 2005, Table *et al.,* 2005, El-Sawi *et al.,* 2006, Gafaar, 2007, Omar, 2007 and Zeidan *et al.* 2007). Though inherent factors within wheat spike which play a great role on floral fertility (Bremner and Pinkerton, 1972, Evans *et al.,* 1972 and Kirby, 1974), there still a role is left to external factors in this respect (Milthorpe and Moorby, 1979, Saleh, 1981 and Catherine *et al.,* 1992).

Concerning the response of wheat to N fertilization under sandy soil conditions, several authors found significant increase in yield of wheat due to the increase of N level up to 40 and 75.5 kg N/fad (Shaaban, 2006 and Weber *et al.,* 2008). Also, others got yield response when they added 100 kg N/fad (Abdul Galil *et al.* 1997 and Abd El-Maaboud *et al.,* 2006). However, Tawfelies and Tammam (2005) got similar response when they added 105 kg N/fad. Moreover, Mowafy (2002-b), AbdulGalil *et al.* (2003), Ali *et al.* (2004) and Mekail *et al.* (2006) found that this response reached 120 kg N/fad. Furthermore, Allam (2003) and Selim (2004) got higher response when they added

125 kg N/fad. Soliman (2000) found similar higher response, but, due to N addition of 180 kg N/fad. In all these responses, the significant increase of yield was attributed to the significant increase of yield attributes.

Therefore, the present study aimed to find out the effect of organic manuring and N fertilization level on floral fertility, inter and intra spikelet competitions and grain yield potentiality of three bread wheat cultivars under sandy soil conditions.

MATERIALS AND METHODS

Two field experiments were conducted in the Experimental Farm of the Faculty of Agriculture, Zagazig University at Khattara, Sharkia Governorate, Egypt during 2004/2005 and 2005/2006 seasons. The study aimed to investigate the effect of organic manuring and N fertilization levels on floral fertility, inter and intra spikelet compitions and grain yield potentiality of three bread wheat cultivars under sandy soil conditions. The soil of the experimental site is sandy in texture where it had a particle size distribution of 89.4, 6.5 and 4.1% for sand, silt and clay, respectively. The soil had an average pH of 7.99 and organic matter content of 0.29%. The average available N, P and K contents were 16.2, 3.7 and 93.8 ppm, respectively (average over the two seasons for the upper 30 cm of soil surface). Each experiment included three factors as follows :

1. Organic manuring :
   a. without manuring
   b. 25 m^3/fad c. 50 m^3/fad
2. Wheat cultivars :
   a. Gemmiza 9 b. Sakha 93
   c. Giza 168
3. Nitrogen levels :
   a. 30 kg N/fad b. 60 kg N/fad
   c. 90 kg N/fad d. 120 kg N/fad

Organic manure (farmyard manure) as delivered from the Agricultural Research Station of the Faculty of Agriculture. It had the following nutrient contents : 321 ppm N, 448 ppm P, 1143 ppm K, 14.04% organic matter, with a pH of 7.06 in the first season and 325 ppm N, 451 ppm P, 1151 ppm K, 14.03% organic matter, with a pH of 7.04 in the second season. Farmyard manure (FYM) was soil incorporated at 10 cm soil depth before sowing. Phosphorus and potassium fertilizers were applied as basal dressing at sowing as superphosphate (15.5% P_2O_5) and potassium sulphate (50% K_2O), respectively. Nitrogen was added in the form of ammonium sulphate (20.5% N) in six splits given at 10 days by interval at 20, 30, 40, 50, 60 and 70 days after sowing. Irrigation was practiced using sprinkler irrigation. Wheat followed fallow preceded, also by wheat.

A split split plot design with four replicates was used where the main plots were occupied by the organic manure rates whereas cultivars and N levels were allotted in the 1st and 2nd sub plots, respectively. Each plot (13.5 m^2) included 20 rows, 15 cm apart (3 m. in width and 4.5 m. in length). Seeds were hand drilled at a rate of 400 seed/m^2 for all the tested cultivars weight on November 20th and 23rd in the two seasons, respectively taking in consideration their test. Harvest date was on the last week of April for Sakha 93 and Giza 168 and in the second week of May for Gemmiza 9 in the two seasons. The other cultural practices for growing wheat under these conditions were applied.

At harvest, five main spikes were randomly taken from guarded rows. Fertile spikelets were dissected from one side of each spike and were placed separately in small bags carrying their location numbers acropetally within each spikelet. The six basal grains were alphabetically designated from base according to their floret positions as a, b, c, d, e and f as shown in Fig. 1. No fertile florets were found beyong the 6th floret position. Individual grain weights were recorded for each grain positions within spikelet according to Lesch *et al.* (1992).

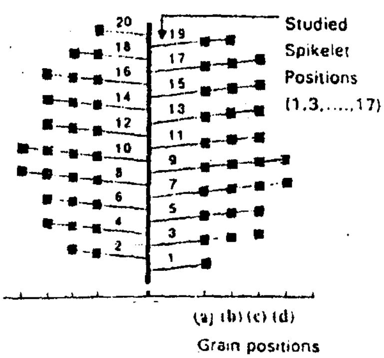

Fig. 1. Geometric representation of a spike, showing how fertile spikelet positions were scaled into spikelet locations and grain positions within spikelet.

From the abovementioned data, individual grain weight and number distributions along rachis, as well as, along rachilla were determined as follows :

a. Grain number distribution along rachis :

Number of grains per each studied spikelet position was recorded along spike axis (rachis).

b. Average single grain weight distribution along rachis :

The average grain weight (mg) per each studied spikelet position was recorded along spike axis through dividing the grains weight/spikelet by grain number of each spikelet position.

c. Average single grain weight distribution along rachilla :

The average grain weight (mg) of each grain position within spikelet was averaged over the nine studied spikelet positions.

d. Inter-Intra spikelet competitions index (IISCI) :

Though variations among individual grain weights along rachis, as well as, along rachilla follow a geometrical pattern according to their floral position, however, Moselhy (1995) and AbdulGalil *et al.* (1997) reported that agronomic practices played a role in these variations. According to them variation among individual grain weights along rachis or along rachilla could be served to express the magnitude of inter and intra spikelet competition, respectively. The IISCI was calculated according to them with the help of the following equation :

$$\text{IISCI} = \frac{\text{C.V. of individual grain weight average along rachis}}{\text{C.V. of individual grain weight average along rachilla}}$$

At harvest, also, plant samples were taken from an area of 0.5 m^2 to determine plant height (cm), number of spikes/m^2, spike length (cm), number of spikelets/ spike, number of grains/spike, thousand grain weight (gm) and grain weight/spike (gm). Grain (kg/fad) and straw (ton/fad) yields were determined from a central area of 6.0 m^2 (ten rows by 4 meter long).

Data were statistically analyzed according to Snedecor and Cochran (1981) as a split-split plot design. Treatments means were compared using LSD. In interaction tables, capital and small letters were used to compare rows and column means, respectively, *,** and N.S denote the significant and highly significant and the insignificant differences in respective order.

For simple comparison between levels averages of any factor under study, the main effect tables are provided with the percentage change for grain yield and its attributes and regression coefficients for floral fertility to express the magnitude of variation.

The response equations were calculated according to Snedecor and Cochran (1981) using the orthogonal polynomial tables for significant interactions between factors under study. The significancy of the linear and quadratic components of each of these equations was tested, then the response could be described as linear (first order) or quadratic (second order). The maximum predicted average (Ymax) which could have been obtained due to addition of the predicted maximum N level (Xmax) was calculated according to Neter *et al.* (1990) and AbdulGalil *et al.* (2003).

RESULTS AND DISCUSSION

Grain and Straw Yields and Their Attributes

Organic manuring effect

Results in Table 1 shows that addition the organic manure and the increase in the rate of addition to 50 m^3/fad was accompanied by a significant increase in each of the grain and straw yields and all their attributes. Organic manured plants were significantly taller and had longer spikes with greater number of spikelets and hence grains/spike than un-organic manured ones. The formers produced larger number of spikes/m^2 than the latters. This increase was not on the expense of the 1000-grain weight or the grain weight/spike as they, also, were significantly increased due to this addition.

These results clearly indicate that organic manuring in such sandy soil was indispensable and effective in ameliorating soil fertility from the physical, chemical and biological points of view (Abd El-Nasser and Hussein, 2001, Basyouny, 2001, Tolessa and Friesen, 2001, Vanlavwe *et al.* 2001, Darwish *et al.,* 2002, Hassan and Mohey El-Din, 2002, Salib *et al.,* 2002 and Yang *et al.,* 2004). Addition of organic manures particularly in light textured soils, was reported to improve soil texture, water holding capacity and availability of plant nutrients (Russel, 1963). The soil of the experimental site is sandy with a very poor fertility level from organic

Table 1. Yield and yield attributes of the tested wheat cultivars as affected by organic manuring and nitrogen levels in the two seasons and their combined

Main effects and interaction	Plant height (cm)			Number of spikes / m^2			Spike length (cm)			Number of spikelets / spike			Number of grains / spike		
	1st	2nd	Comb.	1st	2nd	Comb.	1st	2nd	Comb.	1st	2nd	Comb.	1st	2nd	Comb.
Organic manure : (O)															
Without	81.26 c	89.19 c	85.22 c	272.3 c	283.6 c	277.9 c	6.53 c	7.95 c	7.24 c	13.1 c	14.2 c	13.6 c	37.9 c	41.0 c	39.5 c
$25m^3$ / fad	82.9 b	90.32 b	86.61 b	276.8 b	292.0 b	288.4 b	7.08 b	8.25 b	7.67 b	14.2 b	16.2 b	15.2 b	39.4 b	42.6 b	41.0 b
$50m^3$ / fad	84.44 a	92.12 a	88.28 a	285.9 a	298.6 a	292.3 a	7.79 a	9.43 a	8.61 a	16.6 a	18.2 a	17.4 a	41.6 a	45.1 a	43.3 a
F. test	*	*	**	*	*	**	**	*	**	*	*	**	*	*	**
Difference(%)			3.59			5.18			18.92			27.94			9.62
Cultivars: (C)															
Gemmiza 9	88.82 a	95.76 a	92.29 a	295.6 a	307.3 a	301.3 a	8.22 a	9.01 a	8.62 a	15.8 a	17.7 a	16.8 a	43.5 a	46.7 a	45.1 a
Sakha 93	83.92 b	92.82 b	88.37 b	273.9 b	287.9 b	280.9 b	6.58 b	8.53 b	7.56 b	14.7 b	15.9 b	15.3 b	39.4 b	42.6 b	41.0 b
Giza 168	75.86 c	83.05 c	79.46 c	265.5 c	278.9 c	272.2 c	6.60 b	8.08 c	7.34 c	13.4 c	15.1 c	14.2 c	35.9 c	39.5c	37.7 c
F. test	*	*	**	*	*	**	*	*	**	*	**	**	*	**	**
Nitrogen levels: (N)															
30 kg N/fad	80.69 d	88.63 d	84.66 d	270.4 d	282.1 d	276.3 d	6.47 d	7.78 d	7.12 d	13.3 c	15.0 d	14.1 c	37.4 d	41.02 d	39.2 d
60 kg N/fad	81.98 c	89.79 c	85.89 c	275.7 c	288.1 c	281.9 c	6.87 c	8.25 c	7.56 c	14.1 b	15.5 c	14.8 b	38.8 c	42.1 c	40.4 c
90 kg N/fad	83.78 b	91.32 b	87.55 b	282.8 b	296.6 b	289.7 b	7.38 b	8.86 b	8.12 b	15.2 a	16.9 b	16.1 a	40.9 b	43.9 b	42.4 b
120 kg N/fad	85.02 a	92.41 a	88.71 a	284.4 a	298.8 a	291.6 a	7.82 a	9.28 a	8.55 a	15.9 a	17.5 a	16.7 a	41.4 a	44.6 a	43.0 a
F. test	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
Difference(%)			4.78			5.54			20.08			18.44			9.69
Interactions:															
O x C	N.S	*	N.S	*	N.S	N.S	*	N.S	N.S	*	N.S	N.S	N.S	*	N.S
O x N	N.S	*	*	*	N.S	*	N.S	*	N.S	N.S	*	*	N.S	*	*
C x N	*	**	**	**	*	*	N.S	*	*	N.S	*	N.S	*	*	**
O x C x N	N.S	*	N.S	*	N.S	N.S	N.S	*	N.S	N.S	*	N.S	N.S	*	N.S

*,** and N.S indicate significant at 0.05, 0.01 and insignificant, respectively.

Table 1. Cont.

Main effects and interaction	Thousand grain weight (gm)			Grain weight / spike (gm)			Grain yield / fad (kg/fad)			Straw yield / fad (ton/fad)		
	1st	2nd	Comb.	1st	2nd	Comb.	1st	2nd	Comb.	1st	2nd	Comb.
Organic manure : (O)												
Without	40.67c	41.43c	41.05c	1.482c	1.608c	1.545c	1308.5c	1611.8 c	1460.1 c	2.654 c	3.166 c	2.910 c
$25m^3$ / fad	41.57b	43.23b	42.40b	1.599b	1.734b	1.667b	1379.0b	1658.4 b	1518.7 b	2.807 b	3.292 b	3.049 b
$50m^3$ / fad	42.59a	44.44a	43.52a	1.736a	1.894a	1.815a	1571.7a	1880.6 a	1726.2 a	3.168 a	3.599 a	3.384 a
F. test	*	*	**	*	*	**	**	*	**	*	**	**
Difference(%)			6.02			17.48			18.22			16.29
Cultivars: (C)												
Gemmiza 9	44.56 a	45.26 a	44.91 a	1.900 a	2.009 a	1.954 a	1657.8 a	1971.4 a	1814.6 a	3.352 a	3.807 a	3.579 a
Sakha 93	41.35 b	42.81 b	42.08 b	1.579 b	1.719 b	1.649 b	1369.8 b	1678.7 b	1524.2 b	2.775 b	3.269 b	3.022 b
Giza 168	38.93 c	41.04 c	39.99 c	1.337 c	1.509 c	1.423 c	1231.6 c	1500.8 c	1366.2 c	2.503 c	2.982 c	2.742 c
F. test	*	*	**	*	**	**	*	**	**	*	**	**
Nitrogen levels: (N)												
30 kg N/fad	39.96 b	41.97 c	40.96 b	1.468 c	1.630 d	1.549 d	1175.9 d	1501.5 d	1338.7 d	2.430 d	2.932 d	2.681 d
60 kg N/fad	42.05 a	43.24 b	42.65 a	1.573 b	1.716 c	1.644 c	1362.5 c	1683.0 c	1522.8 c	2.787 c	3.264 c	3.026 c
90 kg N/fad	42.21 a	43.46 a	42.83 a	1.681 a	1.798 b	1.740 b	1555.1 b	1801.7 b	1678.4 b	3.114 b	3.572 b	3.343 b
120 kg N/fad	42.23 a	43.47 a	42.85 a	1.701 a	1.838 a	1.769 a	1585.4 a	1881.5 a	1733.4 a	3.175 a	3.642 a	3.408 a
F. test	*	*	*	*	**	**	*	**	**	*	**	**
Difference(%)			4.61			14.20			29.48			27.12
Interactions:												
O x C	N.S	N.S	N.S	*	N.S	N.S	*	N.S	N.S	*	N.S	N.S
O x N	N.S	N.S	N.S	N.S	*	*	**	N.S	N.S	*	N.S	*
C x N	N.S	N.S	N.S	*	*	**	**	N.S	**	*	*	**
O x C x N	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

*,** and N.S indicate significant at 0.05, 0.01 and insignificant, respectively.

matter (0.29%) and in turn in all the plant nutrients, particularly N (16.2 ppm) and phosphorus (3.7 ppm).

Cultivar differences

The three wheat cultivars varied significantly in grain and straw yields/fad and all of their attributes. Gemmiza 9, followed by Sakha 93 and then Giza 168, had the tallest plants and the longest spikes with the largest number of spikelets and grains/spike. This superiority was also observed in the thousand grain weight and in the number of spikes/m^2. According to the combined analysis, Gemmiza 9 produced grain yield of 1.814 ton/fad whereas Sakha 93 and Giza 168 produced 1.524 and 1.366 ton/fad in respective order. This superiority was also observed in straw yield/fad where the three cultivars produced 3.579, 3.022 and 2.792 ton/fad, respectively.

The present results clearly indicate that the superiority of Gemmiza 9 in height was not on the expense of tillering. Also, the increase in the number of spikes/m^2, was not on the expense of grain weight/spike indicating synochrony of tillering which kept down the inter-spike competition. The data further indicate that the increase in the number of spikelets/spike was not on the expense of the number of grains/spikelet or even on the single grain weight as Gemmiza 9 had the highest averages of these yield attributes. Several workers reported significant varietal differences in yield attributes and yield potentiality among Egyptian wheat cultivars (Mowafy-b, 2002, Allam, 2003, Ali *et al.,* 2004, Allam, 2005, Table *et al.* 2005, El-Sawi *et al.,* 2006, Gafaar, 2007, Omar, 2007 and Zeidan *et al.* 2007).

Nitrogen level effect

Each nitrogen increment produced a significant increase in each of the grain and straw yields/fad and all of their attributes except the thousand grain weight which responded to only the first N increment. Therefore, the increase in grain weight/spike due to each increase in N level up to 120 kg N/fad could be attributed to the increase in grain number/spike rather than single grain weight. Also, the increase in the number of spikes/m^2 did not show any significant decrease in the grain weight/spike. According to these results, wheat plant were in bad need for the increase of N level up to 120 kg N/fad. The percentage increase in gain yield due to the increase of N level from 30 to 120 kg N/fad amounted to 29.5% in grain yield compared with 27.12% in straw yield/fad. Most of this increase could be attributed to the increase of grain weight/spike which amounted to 14.2% rather than the number of spikes/m^2 which amounted to only 5.5%. The increase of grain weight/spike could be attributed to the increase in spike length, number of spikelets/spike where these increases amounted to 20.08 and 18.44% respectively though the increase in grain number/spike was only 9.69%.

Several authors found significant increase in yield and its attributes of wheat due to the increase of N level up to 40 and 75.5 kg N/fad (Shaaban, 2006 and Weber *et al.,* 2008). Also, others got yield response when they added 100 kg N/fad (AbdulGalil *et al.* 1997 and Abd El-Maaboud *et al.,* 2006). However, Tawfelies and Tammam (2005) got similar response when they added 105 kg N/fad. Moreover, Mowafy (2002-b), Abdul Galil *et al.* (2003), Ali *et al.* (2004) and Mekail *et al.* (2006) found that this response reaching 120 kg N/fad. Furthermore, Allam (2003) and Selim (2004) got higher response when they added 125 kg N/fad. In addition Soliman (2000) found similar higher response, but, to N addition of 180 kg N/fad.

Interaction effect

Table 1-a shows the effect of cultivar x N level interaction on grain and straw yields and some of their attributes.

Plant height and spike length showed linear response to the increase of N level but with different magnitudes in the three cultivars. This response was always higher in Gemmiza 9 followed by the response of Sakha 93 and Giza 168 which showed the lowest one. This indicates that the three cultivars under study were in need for a higher N level than 120 kg N/fad to maximize their heights and spike length.

Regarding grain and straw yields/fad, the three cultivars showed diminishing response to the increase of N level. Gemmiza 9 was more efficient and more response than Sakha 93 or Giza 168. The former was in need for a predicted N level of 123.3 to maximize the grain yield to 2.003

Table 1-a. Yield and its attributes as affected by C x N interaction, as well as, response equations and predicted maximum ($\hat{Y}$ max) and N level (X max) (Combined)

Cultivar	N levels (kg N/ fad) 30	60	90	120	Response equations $\hat{Y} = a + bx - cx^2$	$\hat{Y}$ max	X max (kg N/fad)
				Plant height (cm)			
	D	C	B	A			
Gemmiza 9	90.18 a	91.49 a	93.26 a	94.22 a	$\hat{Y} = 90.12 + 1.652x$	--	--
	D	C	B	A			
Sakha 93	86.27 b	87.48 b	89.21 b	90.52 b	$\hat{Y} = 86.22 + 1.52x$	--	--
	D	C	B	A			
Giza 168	77.54 c	78.69 c	80.19 c	81.41 c	$\hat{Y} = 77.80+1.36x$	--	--
				Number of spikes / m^2			
	D	C	B	A			
Gemmiza 9	291.4 a	297.8 a	306.9 a	309.9 a	$\hat{Y} = 290.9 + 9.01x - 0.85x^2$	314.8	189.0
	D	C	B	A			
Sakha 93	272.7 b	278.1 b	285.5 b	287.2 b	$\hat{Y} = 272.3 + 7.87x - 0.925x^2$	289.0	157.5
	D	C	B	A			
Giza 168	264.7 c	269.7 c	276.6 c	277.8 c	$\hat{Y} = 264.3 + 7.47x - 0.950x^2$	279.0	147.9
				Spike length (cm)			
	D	C	B	A			
Gemmiza 9	7.76 a	8.25 a	8.92 a	9.54 a	$\hat{Y} = 7.684 + 0.699x$	--	--
	D	C	B	A			
Sakha 93	6.96 b	7.32 b	7.76 b	8.18 b	$\hat{Y} = 6.930 + 0.455x$	--	--
	D	C	B	A			
Giza 168	6.64 c	7.11 c	7.67 c	7.94 c	$\hat{Y} = 6.621 + 0.596x$	--	--
				Number of grains / spike			
	D	C	B	A			
Gemmiza 9	42.69 a	44.19 a	46.47 a	47.02 a	$\hat{Y} = 42.56 + 2.244x - 0.238x^2$	47.85	171.4
	D	C	B	A			
Sakha 93	39.21 b	40.16 b	41.91 b	42.63 b	$\hat{Y} = 39.12 + 1.38x$	--	--
	D	C	B	A			
Giza 168	35.70 c	36.97 c	38.86 c	39.32 c	$\hat{Y} = 35.59 + 1.88x - 0.203x^2$	39.99	124.2
				Grain weight / spike (gm)			
	D	C	B	A			
Gemmiza 9	1.795 a	1.922 a	2.029 a	2.072 a	$\hat{Y} = 1.798 + 0.157x - 0.021x^2$	2.091	142.1
	D	C	B	A			
Sakha 93	1.539 b	1.613 b	1.710 b	1.733 b	$\hat{Y} = 1.39 + 0.540x - 0.160x^2$	1.855	81.5
	D	C	B	A			
Giza 168	1.312 c	1.398 c	1.480 c	1.504 c	$\hat{Y} = 1.31 + 0.114 - 0.016x^2$	1.513	136.9
				Grain yield (kg / fad)			
	D	C	B	A			
Gemmiza 9	1533.2 a	1767.6 a	1960.1 a	1997.4a	$\hat{Y} = 1527.5+306.4x-49.30x^2$	2003.1	123.3
	D	C	B	A			
Sakha 93	1292.0 b	1473.5 b	1650.3 b	1681.2b	$\hat{Y} = 1284.9+247.4x-37.65x^2$	1694.2	128.6
	D	C	B	A			
Giza 168	1191.0 c	1327.1 c	1425.0 c	1521.7c	$\hat{Y} = 1192.9+138.6x-9.85x^2$	1680.1	240.9
				Straw yield (ton / fad)			
	D	C	B	A			
Gemmiza 9	3.090 a	3.499 a	3.828 a	3.898 a	$\hat{Y} = 3.081+0.497x-0.085x^2$	3.91	123.5
	D	C	B	A			
Sakha 93	2.577 b	2.929 b	3.244 b	3.336 b	$\hat{Y} = 2.569+0.454x-0.065x^2$	3.36	134.8
	D	C	B	A			
Giza 168	2.374 c	2.648 c	2.956 c	2.990 c	$\hat{Y} = 2.358+0.396x-0.06x^2$	3.01	129.0

ton/fad compared with 128.0 kg N/fad needed by Sakha 93 to maximize this yield to 1.694 ton/fad. Giza 168 was the least responsive in this respect as it was in need for 240.9 kg N/fad in order to maximize the grain yield to only 1.680 ton/fad. Similar trend of response was observed in the straw yield/fad (Table 1-a). As far as the grain yield components i.e the number of spikes/m^2 and grain weight/spike, Gemmiza 9 was in need for a higher predicted N level (180.0 kg N/fad) in order to maximize the number of spikes/m^2 and also a less higher N level (142.1 kg N/fad) in order to maximize the grain weight/spike. These results clearly indicate that, the grain weight/spike of Gemmiza 9 was bout to approach a plataue whereas the number of spikes/m^2 did not yet attain its plataue with the addition of the highest N level under study (120 kg N/fad).

These results are quite interesting and explain that the three cultivars responded linearity to the increase of N level regarding their heights and spike length where Gemmiza 9 was more responsive in this respect. However, Gemmiza 9 showed more apical dominance, which is always against tillering. Therefore it was in need for 189.0 kg N/fad to maximize its effective tillering compared with only 142.1 kg N/fad in order to maximize the grain weight/spike.

Table 1-b shows the effect of organic manure x N level on straw yield/fad and some yield attributes. The straw yield/fad showed linear response to the increase of N level in the un-manured plots. This response, however was quadratic in the manured plots where lower N level was needed to maximize the straw yield in the high than in the low manured plots. This trend was, also, observed in the number of spikes/m^2 and could account for the response of straw yield/fad to these additions.

These results clearly indicate that organic manuring played a favourable role in amelioriting the soil fertility, where lower N level was needed to maximize the straw yield/fad in high than in the low N manured plots. Moreover, in the un-manured plots, higher N level than the maximum tried in this study (120 kg N/fad) was needed to maximize the straw yield/fad. The insignificant effect of this interaction on grain yield/fad clearly indicate that the main effects of organic manuring and N level had more pronouncing effect in this respect.

Table 1-b. Yield and its attributes as affected by O x N interaction, as well as, response equations and predicted maximum ($\hat{Y}$ max) and N level (X max) (Combined)

Organic manure(m^3/fad)	N levels (kg N/ fad) 30	60	90	120	Response equations $\hat{Y} = a + bx - cx^2$	$\hat{Y}$ max	X max (kg N/fad)
			Plant height (cm)				
	D	C	B	A			
Without	83.32 c	84.18 c	85.66 c	87.72 c	$\hat{Y} = 82.72 + 2.37x - 0.30\ x^2$	87.39	148.4
	D	C	B	A			
25	84.39 b	85.74 b	87.46 b	88.86 b	$\hat{Y} = 84.34 + 1.55x$	--	--
	C	B	A	A			
50	86.28 a	87.74 a	89.54 a	89.56 a	$\hat{Y} = 86.17 + 2.24x - 0.36\ x^2$	89.67	123.5
			Number of spikes / m^2				
	D	C	B	A			
Without	270.2 c	275.0 c	280.7 c	285.8 c	$\hat{Y} = 269.98 + 5.48x$	--	--
	C	B	A	A			
25	275.2 b	281.0 b	290.5 b	290.8 b	$\hat{Y} = 274.6 + 9.76x - 1.38x^2$	291.9	136.4
	D	C	B	A			
50	283.4 a	289.6 a	297.8 a	298.2 a	$\hat{Y} = 282.9 + 9.61x - 1.45x^2$	298.8	129.4
			Number of spikelets / spike				
	D	C	B	A			
Without	12.11 c	12.61 c	14.06 c	15.73 c	$\hat{Y} = 11.49 + 2.11x - 0.293\ x^2$	15.29	138.0
	D	C	B	A			
25	13.84 b	14.69 b	16.03 b	16.31 b	$\hat{Y} = 13.76 + 1.31x - 0.143\ x^2$	16.73	166.8
	C	B	A	A			
50	16.46 a	16.96 a	18.09 a	18.11 a	$\hat{Y} = 16.38 + 0.968x - 0.120\ x^2$	18.33	151.0
			Number of grains / spike				
	D	C	B	A			
Without	37.21 c	38.22 c	40.36 c	42.07 b	$\hat{Y} = 36.79 + 2.197x$	--	--
	C	B	A	A			
25	39.13 b	40.38 b	42.17 b	42.19 b	$\hat{Y} = 39.02 + 2.020x - 0.308\ x^2$	42.33	128.4
	C	B	A	A			
50	41.26 a	42.72 a	44.70 a	44.71 a	$\hat{Y} = 41.14 + 2.320x - 0.363\ x^2$	44.85	126.0
			Grain weight / spike (gm)				
	D	C	B	A			
Without	1.422 c	1.494 c	1.592 c	1.672 c	$\hat{Y} = 1.416 + 0.910x$	--	--
	C	B	A	A			
25	1.534 b	1.641 b	1.744 b	1.748 b	$\hat{Y} = 0.529 + 0.818x$	--	--
	C	B	A	A			
50	1.690 a	1.799 a	1.883 a	1.889 a	$\hat{Y} = 1.687 + 0.146\ x - 0.026\ x^2$	1.892	114.9
			Straw yield (ton / fad)				
	D	C	B	A			
Without	2.528 c	2.818 c	3.050 c	3.244 c	$\hat{Y} = 2.529 + 0.310x$	--	--
	C	B	A	A			
25	2.618 b	2.955 b	3.312 b	3.313 b	$\hat{Y} = 2.599 + 0.496x - 0.084\ x^2$	3.330	118.6
	C	B	A	A			
50	2.896 a	3.303 a	3.667 a	3.668 a	$\hat{Y} = 2.880 + 0.573x - 0.102\ x^2$	3.685	114.3

Grain Number Distribution Along Rachis

Organic manuring effect

Results in Table 2 shows that addition of the organic manure and the increase in the rate of addition was followed by a significant increase in the number of grains along rachis at all locations, except the 1st one, where the increase of organic manuring from 25 to 50 m^3/fad was not followed by a further significant increase in this respect. This was true in the two seasons and their combined. The regression coefficient as a measure for the response of grain number to organic manuring clearly indicate that the highest response was recorded by position 9 i.e. the central spikelet position along rachis. This response showed inconsistent gradual decrease towards up and downwards positions. These results clearly indicate that manured wheat plants were benefited from organic manuring as far as floral fertility where more florets were obtained with each increase in manuring rate where the central spikelet positions were more responsive to this addition than the distal ones, with few exceptions.

These results explain the increase in the number of grains/spike due to manuring and the increase in its rate of application (Table 1). These results refer to abeneficial effect of organic manuring under such conditions (Heluf, 2002, Mowafy, 2002-a, Khalil and Aly, 2004, Abdel-Ghani and Bakry, 2005 and Ahmed and Ali, 2005).

Cultivar differences

Gemmiza 9 followed by Sakha 93 had larger number of grains/spikelet than Giza 168 at all spikelet positions along rachis. In the three cultivars, the 9th and 11th positions, recorded the highest grain number/spikelet. According to these results, the superiority of Gemmiza 9 in grain weight/spike could be attributed to the high number of grains/spikelet particularly in the central positions. These data are in harmony with those reported by Moselhy (1995), AbdulGalil *et al.* (1997 and 2000) and Mowafy (2002-b).

Nitrogen level effect

In both seasons and their combined and with the exception of the first spikelet location in the second season, the first two N

Table 2. Grain number distribution along rachis of the three wheat cultivars as affected by organic manuring and nitrogen levels in the two seasons and their combined

Main effects and interaction	Spikelet position number from spike base (First season)								
	1	3	5	7	9	11	13	15	17
Organic manure : (O)									
Without	2.920 b	3.258 b	3.302 c	3.695 c	4.809 c	4.326 c	3.352 c	2.730 c	2.562 c
$25m^3$ / fad	3.317 a	3.485 a	3.620 b	3.943 b	5.056 b	4.618 b	3.599 b	2.927 b	2.765 b
$50m^3$ / fad	3.329 a	3.566 a	3.831 a	4.046 a	5.524 a	4.768 a	3.740 a	3.178 a	2.961 a
F. test	*	*	*	*	*	*	*	**	*
Δ	0.205	0.154	0.265	0.176	0.358	0.221	0.194	0.224	0.200
Cultivars: (C)									
Gemmiza 9	3.655 a	3.891 a	4.034 a	4.181 a	5.377 a	4.882 a	3.922 a	3.142 a	2.957 a
Sakha 93	3.338 b	3.467 b	3.567 b	3.987 b	5.206 b	4.536 b	3.514 b	2.973 b	2.747 b
Giza 168	2.573 c	2.950 c	3.152 c	3.517 c	4.807 c	4.294 c	3.255 c	2.720 c	2.583 c
F. test	*	*	*	*	*	*	**	*	**
Nitrogen levels: (N)									
30 kg N/fad	3.097	3.219 c	3.362 c	3.605 c	4.898 c	4.346 c	3.329 c	2.742 c	2.527 c
60 kg N/fad	3.206	3.405 b	3.552 b	3.867 b	5.101 b	4.519 b	3.522 b	2.915 b	2.768 b
90 kg N/fad	3.226	3.560 a	3.711 a	4.053 a	5.259 a	4.708 a	3.701 a	3.061 a	2.875 a
120 kg N/fad	3.227	3.560 a	3.712 a	4.054 a	5.261 a	4.710 a	3.703 a	3.062 a	2.880 a
F. test	N.S	*	*	*	*	*	*	**	*
Δ	--	0.257	1.531	0.349	0.275	0.256	0.273	0.240	0.294
Interactions:									
O x C	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
O x N	*	N.S	N.S	*	*	N.S	N.S	*	N.S
C x N	N.S	**	N.S	**	N.S	**	*	**	N.S
O x C x N	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

Δ Regression coefficient. *,** and N.S indicate significant at 0.05, 0.01 and insignificant, respectively.

Table 2. Cont.

Main effects and interaction	Spikelet position number from spike base (Second season)								
	1	3	5	7	9	11	13	15	17
Organic manure : (O)									
Without	3.642 b	4.211 b	4.258 c	4.714 c	5.818 c	5.329 c	4.352 c	3.728 c	3.692
25m^3 / fad	4.036 a	4.459 a	4.565 b	4.959 b	6.056 b	5.613 b	4.600 b	3.918 b	3.875
50m^3 / fad	4.160 a	4.508 a	4.686 a	5.057 a	6.509 a	5.768 a	4.742 a	4.186 a	3.978
F. test	*	*	*	*	**	*	*	*	N.S
Δ	0.259	0.149	0.214	0.172	0.346	0.220	0.195	0.229	--
Cultivars: (C)									
Gemmiza 9	4.378 a	4.849 a	4.985 a	5.197 a	6.362 a	5.879 a	4.922 a	4.139 a	3.984 a
Sakha 93	4.176 b	4.428 b	4.422 b	5.007 b	6.207 b	5.533 b	4.516 b	3.962 b	3.920 a
Giza 168	3.286 c	3.901 c	4.102 c	4.527 c	5.816 c	5.298 c	4.257 c	3.731 c	3.641 b
F. test	*	**	*	*	**	*	*	*	*
Nitrogen levels: (N)									
30 kg N/fad	3.764 c	4.174 c	4.317 c	4.620 c	5.903 c	5.343 c	4.328 c	3.750 c	3.638
60 kg N/fad	3.879 b	4.374 b	4.461 b	4.885 b	6.106 b	5.521 b	4.523 b	3.908 b	3.756
90 kg N/fad	4.072 a	4.510 a	4.617 a	5.068 a	6.261 a	5.704 a	4.702 a	4.055 a	4.100
120 kg N/fad	4.072 a	4.513 a	4.618 a	5.069 a	6.241 a	5.712 a	4.706 a	4.062 a	3.899
F. test	*	*	*	**	*	*	*	*	N.S
Δ	0.198	0.263	0.213	0.351	0.284	0.257	0.275	0.222	--
Interactions:									
O x C	N.S	N.S	N.S	N.S	*	N.S	N.S	N.S	N.S
O x N	N.S	N.S	*	*	N.S	N.S	*	*	N.S
C x N	N.S	**	**	**	**	**	**	**	N.S
O x C x N	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

Δ Regression coefficient. *,** and N.S indicate significant at 0.05, 0.01 and insignificant, respectively.

Table 2. Cont.

Main effects and interaction	Spikelet position number from spike base (Combined of the two seasons)								
	1	3	5	7	9	11	13	15	17
Organic manure : (O)									
Without	3.281 b	3.734 c	3.780 c	4.205 c	5.314 c	4.828 c	3.852 c	3.229 c	3.127 c
$25m^3$ / fad	3.678 a	3.972 b	4.092 b	4.451 b	5.556 b	5.115 b	4.100 b	3.422 b	3.320 b
$50m^3$ / fad	3.745 a	4.037 a	4.258 a	4.552 a	6.017 a	5.268 a	4.241 a	3.682 a	3.470 a
F. test	**	*	*	*	**	*	**	**	*
Δ	0.232	0.152	0.239	0.174	0.352	0.226	0.195	0.227	0.172
Cultivars: (C)									
Gemmiza 9	4.017 a	4.370 a	4.509 a	4.689 a	5.869 a	5.380 a	4.422 a	3.641 a	3.471 a
Sakha 93	3.757 b	3.947 b	3.994 b	4.497 b	5.706 b	5.034 b	4.015 b	3.467 b	3.334 b
Giza 168	2.930 c	3.426 c	3.627 c	4.022 c	5.311 c	4.796 c	3.756 c	3.225 c	3.112 c
F. test	**	*	*	*	*	**	**	*	*
Nitrogen levels: (N)									
30 kg N/fad	3.430 c	3.697 c	3.839 c	4.112 c	5.401 c	4.844 c	3.828 c	3.246 c	3.082 c
60 kg N/fad	3.543 b	3.890 b	4.007 b	4.376 b	5.604 b	5.020 b	4.023 b	3.412 b	3.262 b
90 kg N/fad	3.649 a	4.035 a	4.164 a	4.560 a	5.760 a	5.206 a	4.202 a	3.558 a	3.488 a
120 kg N/fad	3.650 a	4.037 a	4.165 a	4.562 a	5.751 a	5.211 a	4.202 a	3.562 a	3.389 a
F. test	*	**	*	*	**	*	**	**	**
Δ	0.161	0.260	0.238	0.350	0.280	0.215	0.276	0.230	0.324
Interactions:									
O x C	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
O x N	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
C x N	N.S	**	*	**	**	**	*	**	N.S
O x C x N	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

Δ Regression coefficient. *,** and N.S indicate significant at 0.05, 0.01 and insignificant, respectively.

increments produced a significant increase in the number of grains/spikelet at all spikelet positions. However, the further increase in N level beyond 90 kg N/fad failed to add a significant increase in their number in the first spikelet position was the least responsive to the increase of N level whereas the 7th position was highest responsive in this respect. Also, the distal terminal spikelet position (17th) showed the next higher response to the increase of N level.

These results clearly indicate that N level increase up to 90 kg N/fad played a favourable role regarding floral fertility. Langer and Liew (1973) indicated that N, through promoting photosynthesis and hence making more photosynthates available for floral fertility, was reported to increase the number of grains/spikelet. This effect as ascribed to hormone balance in maize grains where grains with narrow C : N ratio were able to have an ample filling. The present results confirme the aforementioned ones, where the increase of N level increased fruit set particularly in the central spikelet locations in addition to the terminal one at the top of the spike. Moreover, it is evident that in wheat inherent factors within spike play a great role on floral fertility (Bremner and Pinkerton, 1972, Evans *et al.,* 1972 and Kirby, 1974), in addition to the role of external factors in this respect (Milthorpe and Moorby, 1979, Saleh, 1981 and Catherine *et al.,* 1992).

Interaction effect

Table 2 shows some significant interaction effects. Most of them did not bring more information than the main effects of the three factors, under study, therefore their data were not presented.

Average Single Grain Weight Distribution Along Rachis

Organic manuring effect

Results in Table 3 shows that the increase in organic manuring rate up to 50 m^3/fad was followed by a significant increase in the average single grain weight at all spikelet location along rachis. Surprisingly, the three distal locations i.e. 13th, 15th and 17th showed greater response to manuring with very few exceptions. This was not observed in the distribution of grain number in these locations where it showed lower response to manuring (Table 2). This clearly refers to lower intra spikelet competition for

Table 3. Average single grain weight (mg) distribution along rachis of the three wheat cultivars as affected by organic manure and nitrogen levels in the two seasons and their combined

Main effects and interaction	Spikelet position number from spike base (First season)								
	1	3	5	7	9	11	13	15	17
Organic manure : (O)									
Without	38.34 c	41.14 c	44.26 b	45.85 b	47.40 c	45.14 b	40.19 c	35.90 c	30.45 c
$25m^3$ / fad	41.17 b	44.15 b	47.04 a	49.04 a	50.20 b	48.02 a	43.65 b	39.73 b	33.86 b
$50m^3$ / fad	42.08 a	45.18 a	47.78 a	49.94 a	51.12 a	48.74 a	44.69 a	40.72 a	34.96 a
F. test	*	*	*	*	*	*	*	*	*
Δ	1.87	2.02	1.76	2.05	1.86	1.80	2.25	2.41	2.26
Cultivars: (C)									
Gemmiza 9	43.43 a	46.54 a	48.39 a	50.56 a	52.26 a	49.56 a	45.25 a	41.48 a	35.93 a
Sakha 93	40.84 b	44.31 b	46.79 b	48.62 b	49.77 b	47.06 b	43.33 b	38.93 b	33.28 b
Giza 168	37.31 c	39.63 c	43.90 c	45.66 c	46.69 c	45.27 c	39.95 c	35.94 c	30.07 c
F. test	**	**	**	**	**	**	**	*	*
Nitrogen levels: (N)									
30 kg N/fad	38.10 c	41.13 c	43.98 c	45.62 c	47.09 c	44.91 c	40.34 c	36.41 c	30.17 c
60 kg N/fad	40.08 b	43.02 b	45.76 b	47.70 b	49.03 b	46.78 b	42.28 b	38.19 b	32.94 b
90 kg N/fad	41.97 a	44.90 a	47.81 a	49.87 a	51.07 a	48.72 a	44.36 a	40.16 a	34.61 a
120 kg N/fad	41.97 a	44.92 a	47.89 a	49.92 a	51.10 a	48.78 a	44.39 a	40.38 a	34.64 a
F. test	*	*	*	*	*	*	*	*	*
Δ	2.835	2.731	2.660	3.034	3.337	2.716	2.859	2.558	3.561
Interactions:									
O x C	N.S	N.S	N.S	*	N.S	*	*	N.S	N.S
O x N	N.S	N.S	N.S	N.S	*	N.S	N.S	N.S	N.S
C x N	*	*	*	*	*	*	*	N.S	N.S
O x C x N	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

Δ Regression coefficient. *,** and N.S indicate significant at 0.05, 0.01 and insignificant, respectively.

Table 3. Cont.

Main effects and interaction	Spikelet position number from spike base (Second season)								
	1	3	5	7	9	11	13	15	17
				(mg)					
Organic manure : (O)									
Without	40.34 c	42.14 c	45.55 c	46.86 c	49.38 c	46.23 c	42.24 c	36.79 c	31.77 c
$25m^3$ / fad	43.15 b	45.16 b	48.05 a	50.05 a	52.14 b	48.87 b	45.69 b	40.76 b	34.89 b
$50m^3$ / fad	44.37 a	46.20 a	48.74 a	50.94 a	53.18 a	49.77 a	46.60 a	41.75 a	35.60 a
F. test	*	*	*	*	*	*	*	*	*
Δ	2.02	2.03	1.60	2.04	1.90	1.77	2.18	2.48	1.92
Cultivars: (C)									
Gemmiza 9	45.43 a	47.53 a	49.60 a	51.56 a	54.21 a	50.59 a	47.29 a	42.34 a	37.10 a
Sakha 93	42.85 b	45.32 b	47.77 b	49.01 b	51.93 b	48.14 b	45.33 b	39.98 b	34.28 b
Giza 168	39.59 c	40.64 c	44.97 c	46.68 c	48.57 c	46.14 c	41.90 c	36.98 c	30.88 c
F. test	**	**	**	**	**	**	**	**	*
Nitrogen levels: (N)									
30 kg N/fad	40.46 c	42.15 c	44.99 c	46.63 c	49.22 c	45.94 c	42.27 c	37.46 c	31.57 c
60 kg N/fad	42.09 b	44.01 b	46.90 b	48.71 b	50.95 b	47.77 b	44.32 b	39.20 b	33.43 b
90 kg N/fad	43.96 a	45.90 a	48.90 a	50.88 a	53.04 a	49.70 a	46.37 a	41.19 a	35.65 a
120 kg N/fad	43.96 a	45.93 a	48.99 a	50.90 a	53.07 a	49.74 a	46.40 a	41.21 a	35.69 a
F. test	*	**	*	*	*	**	**	*	*
Δ	2.462	2.692	2.765	3.042	2.634	2.676	2.960	2.609	2.828
Interactions:									
O x C	N.S	N.S	*	N.S	N.S	N.S	N.S	N.S	N.S
O x N	N.S	*	N.S	N.S	*	*	N.S	N.S	N.S
C x N	N.S	N.S	*	*	N.S	*	*	*	N.S
O x C x N	N.S	N.S	N.S	*	N.S	N.S	N.S	*	N.S

Δ Regression coefficient. *,** and N.S indicate significant at 0.05, 0.01 and insignificant, respectively.

Table 3. Cont.

Main effects and interaction	Spikelet position number from spike base (mg) (Combined of the two seasons)								
	1	3	5	7	9	11	13	15	17
	(mg)								
Organic manure : (O)									
Without	39.34 c	41.64 c	44.90 c	46.36 c	48.39 c	45.68 c	41.21 c	36.35 c	31.11 c
25m^3 / fad	42.16 b	44.66 b	47.55 b	49.54 b	51.17 b	48.44 b	44.67 b	40.25 b	34.38 b
50m^3 / fad	43.22 a	45.69 a	48.26 a	50.44 a	52.15 a	49.25 a	45.64 a	41.23 a	35.28 a
F. test	*	*	*	*	*	*	*	*	*
Δ	1.94	2.03	1.68	2.04	1.88	1.79	2.22	2.44	2.09
Cultivars: (C)									
Gemmiza 9	44.43 a	47.04 a	49.00 a	51.06 a	53.23 a	50.08 a	46.27 a	41.91 a	36.51 a
Sakha 93	41.84 b	44.81 b	47.28 b	49.11 b	50.85 b	47.60 b	44.33 b	39.46 b	33.78 b
Giza 168	38.45 c	40.13 c	44.43 c	46.17 c	47.63 c	45.71 c	40.93 c	36.46 c	30.47 c
F. test	*	**	**	**	**	**	**	**	**
Nitrogen levels: (N)									
30 kg N/fad	39.28 c	41.64 c	44.49 c	46.13 c	48.15 c	45.42 c	41.31 c	36.94 c	30.87 c
60 kg N/fad	41.08 b	43.52 b	46.33 b	48.21 b	49.99 b	47.28 b	43.30 b	38.69 b	33.19 b
90 kg N/fad	42.87 a	45.40 a	48.35 a	50.38 a	52.05 a	49.21 a	45.36 a	40.68 a	35.13 a
120 kg N/fad	42.97 a	45.43 a	48.44 a	50.41 a	52.09 a	49.26 a	45.40 a	40.80 a	35.17 a
F. test	*	*	**	**	**	**	**	**	**
Δ	2.564	2.528	2.595	3.034	2.736	2.700	2.898	2.582	3.193
Interactions:									
O x C	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
O x N	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
C x N	N.S	*	*	*	*	*	*	N.S	N.S
O x C x N	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

Δ Regression coefficient. *,** and N.S indicate significant at 0.05, 0.01 and insignificant, respectively.

photosynthate in the terminal distal location where the increase of organic manuring rate favoured more grain filling in these locations. However, and at all spikelet locations, this intra-spikelet competition did not ciel the increase of single grain weight.

The soil of the present study is sandy where the addition of organic manure was effective to favour the growth of wheat plants (Table 1), where more photosynthate were available for grain filling particularly in distal locations which had lower number of grains/spikelet than central ones (Table 2).

Cultivar differences

The three cultivars varied significantly in the average single grain weight distribution along rachis, where Gemmiza 9 followed by Sakha 93 had higher averages at all locations than Giza 168 (Table 3). Similar effect was observed in the grain number distribution along rachis (Table 2), indicating that the increase of grain number was not on the expense of single grain weight. These results could account for the heaviest thousand grain weight recorded by Gemmiza 9 and the lightest one which was recorded by Giza 168 (Table 1). These data are in accordance with those reported by AbdulGalil *et al.* (2000) and Mowafy (2002-b).

Nitrogen level effect

In both seasons and their combined, the first two N increments produced a significant increase in the average single grain weight distribution along rachis at all spikelet position. However, the further increase in N level beyond 90 kg N/fad failed to add a significant increase in their weight, where the 3rd spikelet position was the least responsive to the increase of N level whereas the distal terminal spikelet position (17th) was highest responsive in this respect. Also, the 7th position showed the next high response to the increase of N level. Rawson and Evans (1970) indicated that grains in central spikelets are generally heavier than those in distal ones.

Interaction effect

The cultivar x N level interaction affected significantly the single grain weight distribution at all spikelet positions except the two terminal ones. At all locations, Gemmiza 9 could maximize the single grain weight to a heavier average than Sakha 93 or Giza 168. However, in only the 9th location, this cultivar was in need for more N (128.6 kg N/fad) than the other two cultivars in order to maximize the single grain weight. However, Sakha 93 was in need for more N (125.0 kg N/fad) in order to maximize the single grain weight to a lower average in location 5 and 13. This interaction clearly indicate varietal response to the increase of N level regarding the single grain weight which varied from spikelet position to another. However, Gemmiza 9 was always superior in this respect Table 3-a.

Average Single Grain Weight Distribution Along Rachilla

Under optimum growing conditions, Milthorpe and Moorby (1979) indicated that grain weights within spikelet should follow the order c = b > a > d > e. They added that under less optimum condition, grain weights followed the order b > a > c > d > e as obtained herein. Under severe growing conditions, grain in location a is the heaviest followed by grains b, c, d and e in descending order. However, several workers found that grain in location b was always heavier than those in location c or a and in turn those in location d, e and f due to internal factors (Moselhy, 1995, Abdul Galil *et al.,* 1997 and 2000 and Mowafy, 2002-b). This was explained by Abdel-Gawad *et al.* (1982) due to a well developed vascular system serving grain in floret b. However, Brocklehurst (1977) attributed this superiority to a larger number of endosperm cells in grain b.

Organic manuring effect

Results in Table 4 shows that additional of organic manure up to 50 m^3/fad was reflected in a significant increase in the single grain weight at all rachilla locations. However, this effect varied where grains in location (a) followed by these in location (c) made better use from the increase in the level of manuring. The least responsive grain were observed in location (f).

These results clearly indicate that grain (b) had higher sink filling capacity and hence was not in bad need for the increase of organic manuring. However, grains in location (a) and (c) made better use of this addition. These results account for the significant increase of thousand grain weight due to manuring (Table 1). They further indicate that grains in locations (a) followed by those in location (c) were more responsive to this addition than those in location (b) which anatomically has larger grain sink (Lesch *et al.,* 1992).

Table 3-a. Average single grain weight (mg) distribution along rachis for locations 3 to 13 as affected by cultivar x N levels interaction, as well as, response equations and predicted maximum ($\hat{Y}$ max) and N level (X max) (Combined)

Cultivar	N levels (kg N/ fad) 30	60	90	120	Response equations $\hat{Y} = a + bx - cx^2$	$\hat{Y}$ max	X max (kg N/fad)
					Location 3		
	C	B	A	A			
Gemmiza 9	44.69 a	46.54 a	48.45 a	48.47 a	$\hat{Y} = 44.59 + 2.698x - 0.458x^2$	48.566	118.4
	C	B	A	A			
Sakha 93	42.56 b	44.34 b	46.16 b	46.20 b	$\hat{Y} = 42.47 + 2.579x - 0.435x^2$	46.29	118.9
	C	B	A	A			
Giza 168	37.67 c	39.68 c	41.58 c	41.60 c	$\hat{Y} = 37.55 + 2.938x - 0.523x^2$	41.68	114.3
					Location 5		
	C	B	A	A			
Gemmiza 9	46.36 a	48.43 a	50.54 a	50.64 a	$\hat{Y} = 46.258 + 2.974x - 0.493x^2$	50.74	120.5
	C	B	A	A			
Sakha 93	45.00 b	46.66 b	48.70 b	48.76 b	$\hat{Y} = 44.88 + 2.532x - 0.400x^2$	48.89	125.0
	C	B	A	A			
Giza 168	42.09 c	43.90 c	45.82 c	45.93 c	$\hat{Y} = 41.99 + 2.619x - 0.425x^2$	46.03	122.4
					Location 7		
	C	B	A	A			
Gemmiza 9	48.31 a	50.43 a	52.72 a	52.78 a	$\hat{Y} = 48.19 + 3.115x - 0.515x^2$	52.9	120.7
	C	B	A	A			
Sakha 93	46.51 b	48.54 b	50.69 b	50.71 b	$\hat{Y} = 46.40 + 2.98x - 0.503x^2$	50.8	119.0
	C	B	A	A			
Giza 168	43.57 c	45.64 c	47.72 c	47.76 c	$\hat{Y} = 43.47 + 2.99x - 0.508x^2$	47.9	118.2
					Location 9		
	C	B	A	A			
Gemmiza 9	50.73 a	52.43 a	54.87 a	54.90 a	$\hat{Y} = 50.57 + 2.75x - 0.418x^2$	55.1	128.6
	C	B	A	A			
Sakha 93	48.51 b	50.35 b	52.24 b	52.28 b	$\hat{Y} = 48.42 + 2.67x - 0.45x^2$	52.4	119.0
	C	B	A	A			
Giza 168	45.21 c	47.18 c	49.05 c	49.07 c	$\hat{Y} = 45.13 + 2.808x - 0.488x^2$	49.16	116.3
					Location 11		
	C	B	A	A			
Gemmiza 9	47.57 a	49.60 a	51.55 a	51.59 a	$\hat{Y} = 47.48 + 2.89x - 0.498x^2$	51.68	117.2
	C	B	A	A			
Sakha 93	45.32 b	47.09 b	48.97 b	49.02 b	$\hat{Y} = 45.22 + 2.59x - 0.430x^2$	49.12	120.3
	C	B	A	A			
Giza 168	43.38 c	45.14 c	47.11 c	47.18 c	$\hat{Y} = 43.28 + 2.61x - 0.423x^2$	47.29	122.4
					Location 13		
	C	B	A	A			
Gemmiza 9	43.68 a	45.75 a	47.81 a	47.84 a	$\hat{Y} = 43.58 + 2.98x - 0.51x^2$	47.95	117.8
	C	B	A	A			
Sakha 93	41.92 b	43.67 b	45.85 b	45.87 b	$\hat{Y} = 41.79 + 2.701x - 0.433x^2$	46.00	123.6
	C	B	A	A			
Giza 168	38.32 c	40.48 c	42.43 c	42.48 c	$\hat{Y} = 38.24 + 3.026x - 0.528x^2$	42.56	116.0

Table 4. Average single grain weight (mg) distribution along rachilla of the three wheat cultivars as affected by organic manuring and nitrogen levels in the two seasons and their combined

Main effects and interaction	1st season						2nd season						Combined					
	a	b	c	d	e	f	a	b	c	d	e	f	a	b	c	d	e	f
<u>Organic manure: (O)</u>																		
Without	44.05 c	47,60 c	38.17 c	33.87 c	20.12 c	14.09 c	45.36 c	48.62 c	39.46 b	34.91 c	21.51 c	15.38 c	44.71 c	48.11 c	38.82 c	34.39 c	20.81 c	14.74 c
$25m^3$ / fad	47.84 b	50.12 b	41.82 b	35.76 b	23.25 b	16.72 b	49.21 b	51.29 b	43.13 a	36.80 b	24.46 b	18.01 b	48.54 b	50.70 b	42.48 b	36.28 b	23.87 b	17.34 b
$50m^3$ / fad	48.83 a	51.19 a	42.77 a	37.03 a	24.33 a	17.33 a	50.14 a	52.40 a	43.70 a	38.11 a	25.61 a	18.77 a	49.48 a	51.79 a	43.23 a	37.57 a	24.97 a	18.05 a
F. test	*	*	**	*	*	*	*	**	*	**	*	*	**	**	**	*	*	*
Δ	2.39	1.80	2.30	1.58	2.11	1.62	2.39	1.89	2.12	1.60	2.05	1.70	2.39	1.84	2.21	1.59	2.08	1.66
<u>Cultivars: (C)</u>																		
Gemmiza 9	50.08 a	52.73 a	44.08 a	38.32 a	25.32 a	18.50 a	51.51 a	54.06 a	44.88 a	39.35 a	26.63 a	19.92 a	50.79 a	53.40 a	44.48 a	38.84a	25.98 a	19.21 a
Sakha 93	47.18 b	50.18 b	41.22 b	35.95 b	23.42 b	15.97 b	48.37 b	51.20 b	42.55 b	36.99 b	24.69 b	17.40 b	47.78 b	50.69 b	41.89 b	36.47 b	24.07 b	16.69 b
Giza 168	43.47 c	46.00 c	37.46 c	32.39 c	18.95 c	13.66 c	44.83 c	47.04 c	38.86 c	33.48 c	20.26 c	14.85 c	44.15 c	46.52 c	38.16 c	32.93 c	29.61 c	14.25 c
F. test	*	**	*	*	**	*	*	**	*	*	**	*	**	**	**	**	*	*
<u>Nitrogen levels: (N)</u>																		
30 kg N/fad	44.25 c	49.92 c	38.48 c	33.16 c	20.10 c	14.16 c	45.50 c	47.96 c	39.80 c	34.16 c	21.21 c	15.43 c	44.87 c	47.44 c	39.14 c	33.66 c	20.65 c	14.79 c
60 kg N/fad	46.49 b	49.33 b	40.29 b	35.05 b	22.29 b	15.91 b	47.68 b	50.35 b	41.70 b	36.08 b	23.56 b	17.27 b	47.08 b	49.84 b	40.99 b	35.57 b	22.92 b	16.59 b
90 kg N/fad	48.45 a	51.24 a	42.44 a	36.99 a	23.93 a	17.04 a	49.88 a	52.37 a	43.45 a	38.08 a	25.33 a	18.42 a	49.16 a	51.75 a	42.94 a	37.54 a	24.63 a	17.73 a
120 kg N/fad	48.45 a	51.16 a	42.47 a	37.01 a	23.97 a	17.07 a	49.89 a	52.38 a	43.45 a	38.10 a	25.34 a	18.43 a	49.17 a	51.77 a	42.96 a	37.56 a	24.64 a	17.75 a
F. test	**	**	**	*	**	*	**	**	**	**	*	**	**	**	*	*	*	*
Δ	3.136	0.944	2.746	2.752	1.325	2.276	3.165	3.311	2.695	2.805	3.176	2.388	3.148	3.274	2.718	2.787	3.063	2.237
<u>Interactions:</u>																		
O x C	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
O x N	*	*	*	*	*	*	*	*	N.S	*	*	N.S	*	*	N.S	*	*	*
C x N	*	*	*	*	*	*	*	*	N.S	*	*	**	*	*	N.S	*	*	*
O x C x N	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

Δ Regression coefficient. ***,** and N.S indicate significant at 0.05, 0.01 and insignificant, respectively.**

Cultivar differences

At all grain locations along rachilla, Gemmiza 9 had significantly heavier single grain weight followed by Sakha 93 and Giza 168, respectively (Table 4). Similar superiority was observed in grain number distribution along rachis (Table 3), indicating that the inter spikelet competition did not hinder or ceil grain filling at all rachilla locations. Similar results were reported by Catherine *et al.* (1992) and Mowafy (2002).

Nitrogen level effect

In both seasons and their combined, each N increment up to the addition of 90 kg N/fad yielded a significant increase in the single grain weight at all rachilla locations. However, grains at location (b) followed by grains at location (a) recorded higher response to the increase of N level than the rest of grains along rachilla. These results were observed in the single grain weight along rachis (Table 3) indicating that 90 kg N/fad were enough to maximize the grain weight at the different rachilla locations particularly at (b) and (a) ones. Lesch *et al.* (1992) found that grain weight was highly dependent on spikelet location along the spike and grain position within the spikelet.

Interaction effect

The cultivar x N level interaction affected significantly the single grain weight at all rachilla locations except location (c). It is evident that Gemmiza 9 was in need for lower N level than 120 kg N/fad in order to maximize the single grain weight. However, at location (b), Sakha 93 and Giza 168 were in need for 122.5 and 123.8 kg N/fad in order to maximize their single grain weight to a lighter weight than Gemmiza 9. This was, also, true at all grain locations along rachilla (Table 4-a). This interaction clearly indicate that Gemmiza 9 was more efficient and also more responsive to the increase of N level through serving N level increase in maximizing the single grain weight at all rachilla locations. This explains the superiority of this cultivar in thousand grain weight Table 1.

The insignificancy of the present interaction on the single grain weight at location (c) is interesting and indicates that the three tested cultivars were equally responsive to the increase in N level in this grain location. Grains in location (c) are, always, suffer from an intra-spikelet competition with the grains in the higher locations, due to sharing

Table 4-a. Average single grain weight (mg) distribution along rachilla for grain a to f as affected by cultivar x N levels interaction, as well as, response equations and predicted maximum ($\hat{Y}$ max) and N level (X max) (Combined)

Cultivar	N levels (kg N/ fad) 30	60	90	120	Response equations $\hat{Y} = a + bx - cx^2$	$\hat{Y}$ max	X max (kg N/fad)
				Grain (a)			
	B	C	A	A			
Gemmiza 9	48.12 a	50.34 a	52.35 a	52.36 a	$\hat{Y} = 48.03 + 3.13x - 0.553x^2$	52.46	114.9
	C	B	A	A			
Sakha 93	44.99 b	47.22 b	49.44 b	49.46 b	$\hat{Y} = 44.88 + 3.22x - 0.553x^2$	49.57	117.4
	C	B	A	A			
Giza 168	41.51 c	43.69 c	45.70 c	45.68 c	$\hat{Y} = 41.42 + 3.102x - 0.550x^2$	45.79	114.6
				Grain (b)			
	C	B	A	A			
Gemmiza 9	50.23 a	53.04 a	55.13 a	55.18 a	$\hat{Y} = 50.16 + 3.764x - 0.690x^2$	55.3	111.8
	C	B	A	A			
Sakha 93	48.08 b	50.45 b	52.10 b	52.11 b	$\hat{Y} = 48.04 + 3.140x - 0.590x^2$	52.2	109.9
	C	B	A	A			
Giza 168	44.01 c	46.04 c	48.01 c	48.02 c	$\hat{Y} = 43.92 + 2.920x - 0.505x^2$	48.2	116.6
				Grain (d)			
	C	B	A	A			
Gemmiza 9	36.05 a	38.41 a	40.44 a	40.46 a	$\hat{Y} = 35.97 + 3.280x - 0.585x^2$	40.57	114.1
	C	B	A	A			
Sakha 93	34.11 b	35.94 b	37.90 b	37.92 b	$\hat{Y} = 34.04 + 2.610x - 0.423x^2$	38.06	122.5
	C	B	A	A			
Giza 168	30.81 c	32.35 c	34.27 c	34.29 c	$\hat{Y} = 30.70 + 2.376x - 0.380x^2$	34.41	123.8
				Grain (e)			
	C	B	A	A			
Gemmiza 9	23.19 a	25.67 a	27.52 a	27.53 a	$\hat{Y} = 23.13 + 3.347x - 0.620x^2$	27.65	110.9
	C	B	A	A			
Sakha 93	21.41 b	23.73 b	25.54 b	25.55 b	$\hat{Y} = 21.35 + 3.160x - 0.578x^2$	25.66	111.9
	C	B	A	A			
Giza 168	17.36 c	19.37 c	20.85 c	20.85 c	$\hat{Y} = 17.32 + 2.703x - 0.503x^2$	20.95	110.6
				Grain (f)			
	C	B	A	A			
Gemmiza 9	17.18 a	19.01 a	20.31 a	20.33 a	$\hat{Y} = 17.15 + 2.430x - 0.453x^2$	20.42	110.6
	C	B	A	A			
Sakha 93	14.77 b	16.58 b	17.69 b	17.71 b	$\hat{Y} = 14.75 + 2.336x - 0.448x^2$	17.79	108.2
	C	B	A	A			
Giza 168	12.43 c	14.17 c	15.20 c	15.21 c	$\hat{Y} = 12.41 + 2.236x - 0.433x^2$	15.30	107.5

conducting vessels. Hay and Walker (1989) indicted that grains in location (a), (b) and (c) are connected in parallel to the source of assimilates and might therefore be expected to respond similarly to a reduction of assimilate supply. However, the vascular connection to grain (c) is longer than that serving grains (a) and (b) and the effect of the consequently greater resistance become, increasingly obvious as the supply of assimilates is reduced. Grain (c) is further disadvantaged by its connection in series with grain d, e, … etc, and such a linkage could account for the response of the more distal grains to shortage of assimilates.

These findings clarify that no one of the tested cultivars under study has specific advantage in serving grains in location (c) and hence they are equally responsive to the increase of N level as far as the single grain weight at this location. The results further indicate that Gemmiza 9 had specific advantage in serving the increase in N level at all rachilla locations, particularly at location (d) where it served 114.1 kg N/fad in maximising the single grain weight to 40.57 mg compared with 125.5 and 123.8 kg N/fad needed to maximize this weight to only 38.06 and 34.41 mg in Sakha 93 and Giza 168, respectively.

Inter and Intra Spikelet Competitions (IISCI)

The inter and intra spikelet competitions (IISCI) is expressed in the present study as was earlier reported by AbdulGalil *et al.* (1997) in the coefficient of variation in the single grain weight along rachis (inter-spikelet coefficient of variation) and as well along rachilla (intra-spikelet coefficient of variation). The first is served to expresses the inter spikelet competition whereas the second expresses the intra spikelet competition (Table 5).

Organic manuring effect

In the fist season, and the combined of the two seasons, each increase in the rate of organic manuring, was reflected in a significant decrease in both the inter and intra spikelet competitions. This was observed in the second season, but the increase in organic manure rate beyond 25 m^3 did not yield a significant decrease in both competitions. The results in Table 5 clearly indicate that the intra spikelet competition was more than thrice the inter spikelet competition. The inter-intra

Table 5. Inter and intra-spikelet coefficients of variation (%) and inter-intra spikelet competition index (IISCI) of the three wheat cultivars as affected by organic manuring and nitrogen levels in the two seasons and their combined

Main effects and interaction	1st season			2nd season			Combined		
	Inter-spikelet CV (%)	Intra-spikelet CV (%)	IISCI	Inter-spikelet CV (%)	Intra-spikelet CV (%)	IISCI	Inter-spikelet CV (%)	Intra-spikelet CV (%)	IISCI
Organic manure : (O)									
Without	13.33 a	40.67 a	0.330 a	12.99 a	38.91 a	0.334	13.16 a	39.79 a	0.332 a
25m^3 / fad	11.93 b	37.94 b	0.314 b	11.71 b	36.59 b	0.321	11.82 b	37.27 b	0.317 b
50m^3 / fad	11.41 c	37.15 c	0.308 b	11.44 b	36.23 b	0.327	11.42 c	36.69 c	0.317 b
F. test	*	*	*	*	*	N.S	*	*	*
Cultivars: (C)									
Gemmiza 9	11.05 c	36.09 c	0.307 b	10.82 c	34.95 c	0.310 b	10.93 c	35.52 c	0.309 c
Sakha 93	12.09 b	38.12 b	0.319 a	12.02 b	36.57 b	0.329 a	12.05 b	37.34 b	0.324 b
Giza 168	13.53 a	41.55 a	0.326 a	13.29 a	40.20 a	0.342 a	13.41 a	40.88 a	0.334 a
F. test	*	**	*	*	**	*	**	**	**
Nitrogen levels: (N)									
30 kg N/fad	13.04 a	41.04 a	0.320	12.88 a	39.15 a	0.330	12.96 a	40.09 a	0.325
60 kg N/fad	12.16 b	38.51 b	0.316	11.92 b	37.22 b	0.325	12.04 b	37.86 b	0.320
90 kg N/fad	11.86 c	37.36 c	0.317	11.72 bc	36.30 c	0.328	11.79 c	36.83 c	0.323
120 kg N/fad	11.82 c	37.44 c	0.316	11.65 c	36.29 c	0.326	11.73 c	36.87 c	0.321
F. test	**	**	N.S	*	**	N.S	*	**	N.S
Interactions:									
O x C	*	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S
O x N	N.S	N.S	N.S	N.S	*	N.S	N.S	N.S	N.S
C x N	*	**	*	N.S	N.S	N.S	N.S	N.S	N.S
O x C x N	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S

*,** and N.S indicate significant at 0.05, 0.01 and insignificant, respectively.

spikelet competition index (IISCI) which expresses the ratio of these two competitions was also decreased due to organic manuring. The increase in the rate of manuring did not add a further significant decrease in IISCI.

These results are quite interesting as they clearly indicate that addition of organic manure afforded wheat plants more available photosynthates for grain filling and hence the competition among grains along rachis and, also, along rachilla was decreased as expressed in the significant decrease in the coefficient of variation in their individual grain weights. Addition of 25 m^3/fad had more significant effect in this respect, where the increase in the rate of application from 25 to 50 m^3/fad was equally effective on both competitions and hence the decrease of IISCI was not significant. These results clearly explained and account for the increase in the thousand grain weight due to organic manuring up to the addition of 50 m^3/fad (Table 1).

Cultivar differences

In both seasons and their combined, Gemmiza 9 was afforded the lowest inter and intra spikelet competitions whereas Giza 168 was the most suffering from these competitions where it recorded the highest averages (Table 5). Regarding IISCI, Gemmiza 9 had lower average than either Sakha 93 or Giza 168 which had at par averages. These results confirm the view that Gemmiza 9 had more grain yield potentiality followed by Sakha 93 and Giza 168 which had the least. This yield potentiality was expressed in plant height, number of grains/m^2 and grain weight/spike (Table 1). The results observed herein in inter and intra spikelet competitions indicate that Gemmiza 9 had more available assimilates for filling larger number of grains/spikelet and to keep down the competition between them within spikelet where the variation in their weights along rachilla was decreased. The competition between grains along rachis though was limited, however, it was, also, decreased to a more extent in Gemmiza 9 than in Sakha 93 or Giza 168. AbdulGalil *et al.* (2000) found varietal differences in (IISCI) as observed herein.

Nitrogen level effect

Each increase in N level up to the addition of 90 kg N/fad was followed by a significant decrease in both the inter and intra coefficients of variation. However, the IISCI was not significantly affected by these additions (Table 5). These results refer to more availability of assimilates with each N increment up to the addition of 90 kg N/fad. This availability was reflected in a significant decrease in the inter and intra coefficient of variations. The insignificancy of differences in IISCI indicates that the decrease in both competitions was equally proportional with the increase of N level. Intra CV was greater than the inter CV indicating that the magnitude of variation among single grain weights along rachilla was greater than among these weights along rachis.

Interaction effect

According to the combined analysis, the inter and intra spikelet coefficients of variation and their index were not significantly affected by any of the interactions between the three factors under study (Table 5).

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تأثير التسميد العضوى ومستوى التسميد النيتروجينى على خصوبة الزُهيرات، المنافسة بين وداخل السنيبلات والقدرة المحصولية لثلاث أصناف من قمح الخبز تحت ظروف الأراضى الرملية

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أقيمت تجربتان حقليتان بمحطة التجارب الزراعية بالخطارة التابعة لكلية الزراعة – جامعة الزقازيق – محافظة الشرقية خلال موسمى ٢٠٠٤/٢٠٠٥ ، ٢٠٠٥/٢٠٠٦ لدراسة تأثير ثلاث مستويات من التسميد العضوى (بدون إضافة – ٢٥ – ٥٠ م^3/فدان) وأربع مستويات من النيتروجين (٣٠ – ٦٠ – ٩٠ – ١٢٠ كجم ن/ف) على خصوبة الزُهيرات ، المنافسة بين وداخل السنيبلات والقدرة المحصولية لثلاث أصناف من قمح الخبز (جميزة ٩ – سخا ٩٣ – جيزة ١٦٨) تحت ظروف الأراضى الرملية. ويمكن تلخيص أهم النتائج فيما يلى :

- أدى إضافة التسميد العضوى وزيادة معدل هذه الإضافة حتى ٥٠ م^3/فدان لزيادة معنوية فى كل من محصولى الحبوب والقش ومؤشراتهما ، عدد الحبوب عند معظم المواقع بمحور السنبلة ، متوسط وزن الحبة على محور السنبلة ومتوسط وزنها على محور السنيبلة مما ساعد على خفض قيم المنافسة بين وداخل السنيبلات وكذلك دليل هذه المنافسة.
- تفوق الصنف جميزة ٩ فى محصولى الحبوب والقش على كل من سخا ٩٣ ، جيزة ١٦٨ وذلك بفضل تفوقه فى كل من إرتفاع النبات ، عدد السنابل / م^2 ، عدد السنيبلات / سنبلة و عدد ووزن حبوب السنبلة. كما تفوق فى توزيع عدد الحبوب عند كل المواقع على محور السنبلة ، متوسط وزن الحبة على محور السنبلة ومتوسط وزنها على محور السنيبلة وذلك بفضل تسجيل أقل القيم فى كل من المنافسة بين وداخل السنيبلات وأيضاً دليل هذه المنافسة فى حين سجل الصنف جيزة ١٦٨ أعلى قيم لهذه المنافسة ودليلها وبالتالى سجل أقل محصول حبوب/ فدان.

- أوضح التحليل التجميعى للموسمين أن زيادة مستوى إضافة السماد النيتروجينى حتى ١٢٠ كجم ن/ف أدى لزيادة معنوية فى كل من ارتفاع النبات ، عدد السنابل/م٢ ، طول السنبلة ، عدد ووزن حبوب السنبلة ومحصولى الحبوب والقش/فدان. كما استجاب كل من عدد السنيبلات / سنبلة ، توزيع عدد الحبوب عند معظم المواقع بمحور السنبلة ، متوسط وزن الحبة على محور السنبلة ومتوسط وزنها على محور السنيبلة بزيادة مستوى الأزوت حتى ٩٠ كجم ن/ف مما ساعد على خفض قيم المنافسة بين وداخل السنيبلات فى حين لم تتأثر قيمة دليل المنافسة بين وداخل السنيبلات بإضافة النيتروجين وبصفة عامة كانت قيم المنافسة داخل السنيبلات أعلى من قيم المنافسة بين السنيبلات.
- أوضحت نتائج التحليل التجميعى للموسمين وجود تداخل فعل بين الأصناف من ناحية وبين كل من التسميد العضوى ومستويات النيتروجين حيث لوحظ أن الصنف جميزة ٩ كان أكثر استجابة لإضافة النيتروجين عن كل من سخا ٩٣ وجيزة ١٦٨ حيث أنه يمكن معظمة محصول الحبوب/ فدان للصنف جميزة ٩ إلى ٢,٠٠٣ طن/فدان عند زيادة مستوى النيتروجين (X_{max}) حتى ١٢٣ كجم ن/ف فى حين يحتاج الصنف سخا ٩٣ لحوالى ١٢٨,٦ كجم ن/ف لمعظمة محصول حبوبه إلى ١,٦٩٤ طن/ف ويمكن معظمة محصول الحبوب للصنف جيزة ١٦٨ إلى ١,٦٨٠ طن/ف بإضافة ٢٤٠,٩ كجم ن/ف. ويمكن معظمة عدد الحبوب بالسنبلة إلى ٤٤,٨٥ حبة بإضافة ١٢٦ كجم ن/ف فى حالة إضافة ٥٠ م٣/ف سماد عضوى فى حين يحتاج إلى ١٢٨ كجم ن/ف لمعظمته إلى ٤٢,٣٣ فى حالة إضافة ٢٥ م٣/ف سماد عضوى ويمكن معظمة عدد السنابل/م٢ إلى ٢٩٨,٨ و ٢٩١,٩ بإضافة ١٢٩,٤ ، ١٣٦,٤ كجم ن/ف فى حالة إضافة ٥٠، ٢٥ م٣/ف على الترتيب مما يوضح أن التسميد العضوى أفاد فى خفض مستوى النيتروجين المضاف حيث لعب دوراً تعويضياً فى التأثير على بعض مكونات المحصول.